

*Supplement of*

**Empirical correction of systematic orthorectification error in Sentinel-2 velocity fields for Greenlandic outlet glaciers**

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10 **Table S1. Centroids of the  $1 \times 1$  km sample sites for the four glaciers discussed in the main text, in NSIDC Polar Stereographic North coordinates. Consult figure 1 in the main text for visual representations of these points.**

<b>Glacier</b>	<b>Point (a)</b>	<b>Point (b)</b>	<b>Point (c)</b>	<b>Point (d)</b>
Helheim Glacier	305860, -2577321	297838, -2571506	289595, -2561353	280915, -2552711
Store Glacier	-207206, -2134107	-199697, -2129783	-187593, -2121311	-177184, -2112596
Jakobshavn Isbræ	-180671, -2278012	-176451, -2281247	-166075, -2279656	-152440, -2274202
Kangerlussuaq Glacier	487319, -2290512	481339, -2282345	478216, -2272442	477725, -2264355

**Table S2. Comparison between GP fit and Sentinel-1 MEaSURES data.**

<b>Glacier</b>	<b>Sample Point</b>	<b>Mean difference from GP fit [m d<sup>-1</sup>]</b>	<b>68th percentile absolute difference from GP fit [m d<sup>-1</sup>]</b>	<b>95th percentile absolute difference from GP fit [m d<sup>-1</sup>]</b>	<b>Percentage of observations within error [%]</b>
Helheim	(a)	0.30	0.53	1.10	87.9
	(b)	-0.47	0.59	0.98	52.3
	(c)	0.06	0.19	0.36	96.6
	(d)	-0.03	0.18	0.50	95.1
Jakobshavn	(a)	-0.40	0.77	2.98	97.6
	(b)	-0.72	1.09	1.84	85.8
	(c)	0.38	0.41	1.26	74.1
	(d)	0.27	0.36	0.69	84.7
Store	(a)	0.24	0.43	0.87	98.2

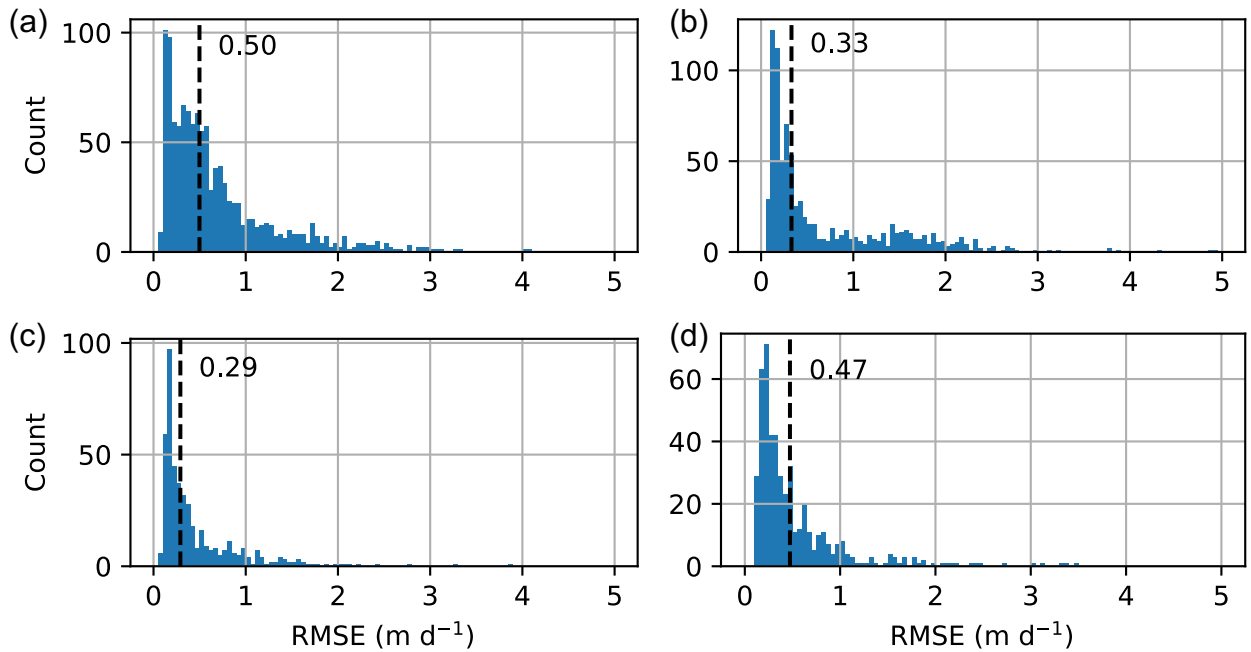
	(b)	0.32	0.42	0.76	86.3
	(c)	0.26	0.34	0.53	57.4
	(d)	0.39	0.41	0.49	95.8
Kangerlussuaq	(a)	-0.24	0.71	1.33	71.3
	(b)	-0.05	0.28	0.55	93.1
	(c)	0.07	0.22	0.44	96.3
	(d)	0.08	0.27	0.59	95.2
<b>Median of all sites</b>		<b>0.08</b>	<b>0.41</b>	<b>0.73</b>	<b>90.5</b>

Table S3: Comparison between GP fit and Landsat-8 ITS\_LIVE data.

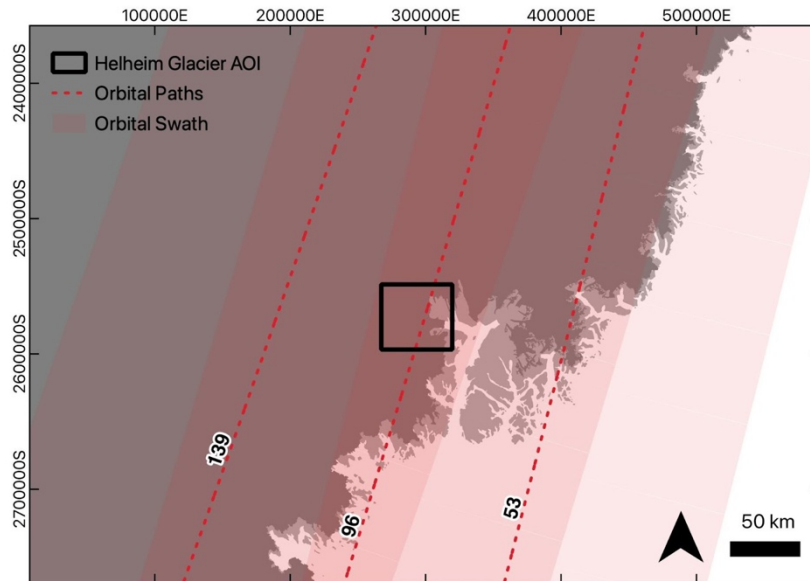
Glacier	Sample Site	Mean difference from GP fit [m d <sup>-1</sup> ]	68th percentile absolute difference from GP fit [m d <sup>-1</sup> ]	95th percentile absolute difference from GP fit [m d <sup>-1</sup> ]	Percentage of observations within error [%]
Helheim	(a)	-0.23	0.31	0.67	97.6
	(b)	0.08	0.18	0.31	97.6
	(c)	-0.14	0.23	0.37	87.4
	(d)	-0.09	0.17	0.37	80.4
Jakobshavn	(a)	-0.74	0.97	1.44	61.4
	(b)	0.12	0.32	0.69	96.4
	(c)	0.33	0.36	0.74	58.8

	(d)	0.31	0.36	0.63	44.32
Store	(a)	0.13	0.24	0.63	100.0
	(b)	0.13	0.18	0.50	98.5
	(c)	0.12	0.16	0.44	93.6
	(d)	0.48	0.52	0.72	70.7
Kangerlussuaq	(a)	-0.57	0.74	1.13	34.0
	(b)	0.14	0.26	0.53	100.0
	(c)	0.10	0.22	0.53	86.5
	(d)	0.27	0.43	0.81	79.3
<b>Median of all sites</b>		<b>0.12</b>	<b>0.29</b>	<b>0.63</b>	<b>87.0</b>

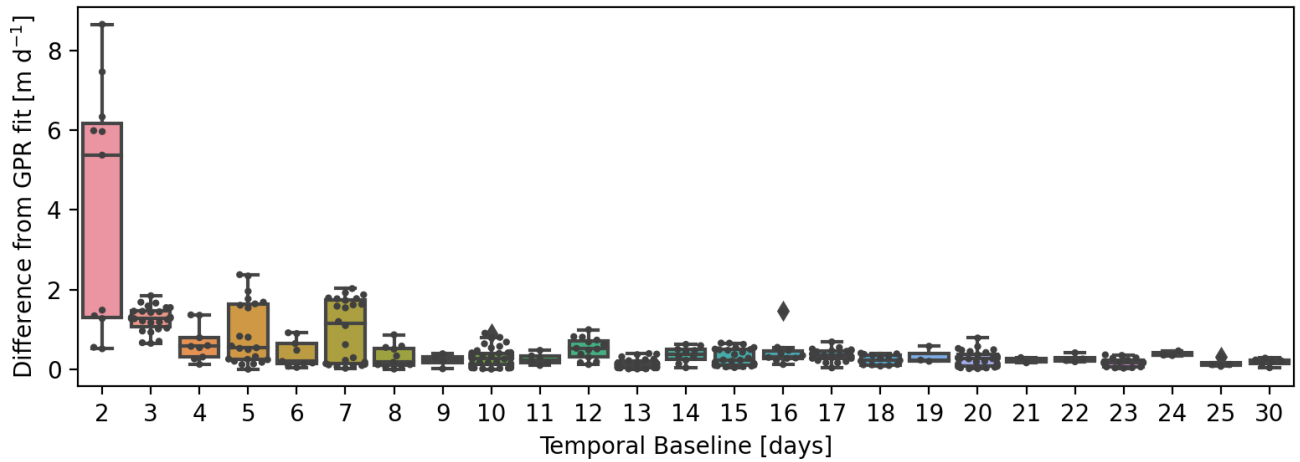
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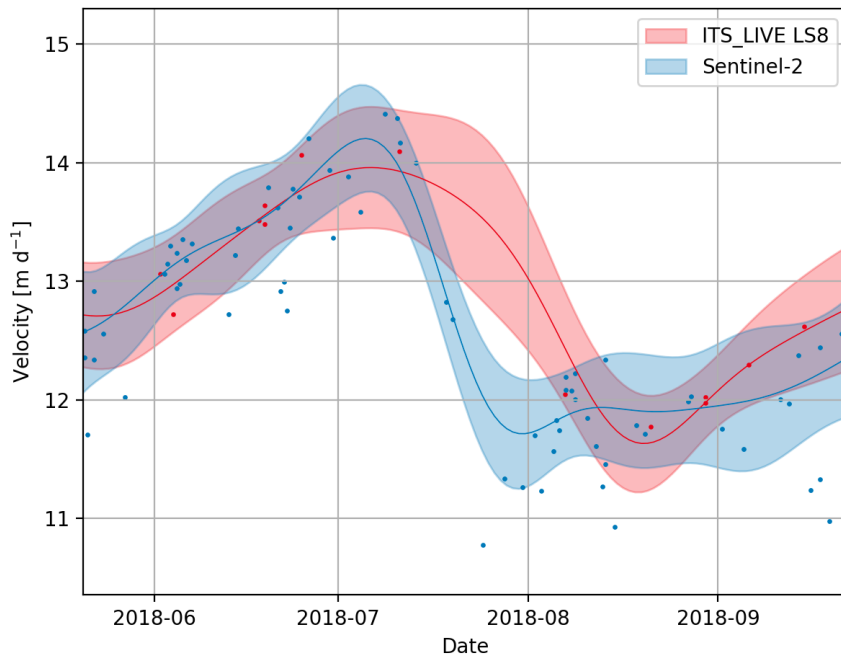
20 **Figure S1:** Histograms of root mean square error (RMSE) distribution across all velocity fields at the four study glaciers, with the dotted line marking the median RMSE value: (a) Store Glacier (median  $0.50 \text{ m d}^{-1}$ ); (b) Jakobshavn Isbræ (median  $0.33 \text{ m d}^{-1}$ ); (c) Helheim Glacier (median  $0.29 \text{ m d}^{-1}$ ); (d) Kangerlussuaq (median  $0.47 \text{ m d}^{-1}$ )



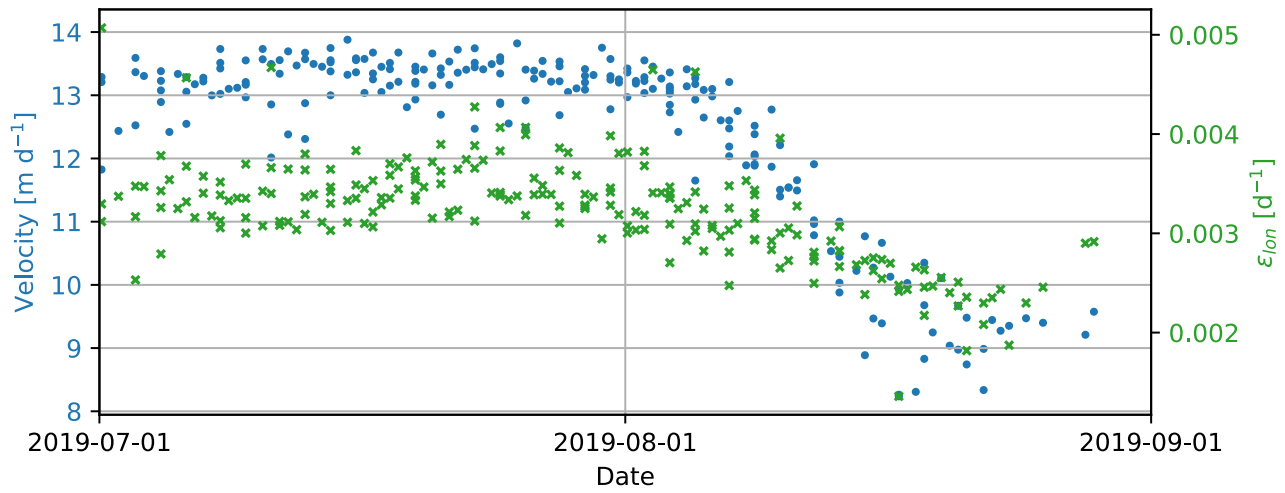
**Figure S2:** Relative orbits of Sentinel-2 tracks covering Helheim Glacier AOI. Coordinates in NSIDC Polar Stereographic North.



25 **Figure S3. Boxplots showing difference between corrected velocity measurement and fitted velocity at Helheim Glacier, separated by temporal baseline.**



30 **Figure S4: Summer slowdown at Store Glacier site (a) in 2018, highlighting the inability to capture the rapid slowdown in sparse Landsat-8 derived data. Points mark individual velocity measurements, solid lines are Gaussian Process models, and shaded regions mark the 2-sigma confidence interval.**



35 **Figure S5: Glacier velocity (blue points) and longitudinal strain rate (green crosses) for Store Glacier sample point a in July and August 2019. Strain rates are derived from glacier velocity fields following Alley *et al.* (2018) with a length scale of 200 m.**